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**JAPANESE** [JP,2000-032007,A]

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CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART TECHNICAL PROBLEM  
MEANS DESCRIPTION OF DRAWINGS DRAWINGS

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[Translation done.]

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**CLAIMS**

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**[Claim(s)]**

[Claim 1] The source for having the protocol with which it was beforehand set for transmitting a packet flow to the destination through an ATM network, and transmitting an ATM cel sequence using an intact virtual channel identifier (VCI), In the network system equipped with the node which has a router and an ATM switch the above-mentioned router Without performing signaling by hop BAIHOPPU, one of two or more of the output ports is related with the above-mentioned intact VCI, and this sets change-over pass. The above-mentioned ATM switch When each of the above-mentioned ATM cel has the same VCI as the above-mentioned intact VCI An ATM cel is transmitted through the above-mentioned one among two or more above-mentioned output ports, without being based on control of the above-mentioned router. A multicast virtual channel (VC) the address corresponding to an IP multicast group The system by which it is obtained by mapping for VC number corresponding to the above-mentioned multicast VC, and at least one base station is characterized by giving VC number to the new mobile which joins one of the above-mentioned IP multicast groups using the above-mentioned mapping.

[Claim 2] The above-mentioned base station is a system according to claim 1 characterized by determining the correspondence relation between VC and a mobile.

[Claim 3] The system according to claim 1 characterized by building beforehand the congruence directional control VC for transmitting the control message between the unidirectional broadcasting VC to a mobile from the above-mentioned base station, the above-mentioned base station, and the above-mentioned mobile.

[Claim 4] The control protocol between the above-mentioned base station and a mobile is VC. REQUEST and VC It has a RECLAIM control message and is Above VC. In order to require VC which should send out data of the above-mentioned base station, it is used by the mobile, and a REQUEST message is Above VC. A RECLAIM message is a system according to claim 1 characterized by being used by the base station in order to carry out reclaim of the above VC assigned to the above-mentioned mobile.

[Claim 5] The above-mentioned base station is a system according to claim 1 characterized by detecting a packet boundary and merging two or more flows in one VC.

[Claim 6] The above-mentioned base station is a transmitting agency IP address, the multicast group address, and a system according to claim 1 characterized by holding the mapping relation between VC numbers.

[Claim 7] The system according to claim 1 characterized by extending an Internet Group Mangement Protocol (IGMP), and for a multicast mobile receiving the above-mentioned IGMP message, generating a suitable report, and a non-multicast mobile discarding the above-mentioned IGMP message in IP level so that the query in the format of a down link IGMP message may be transmitted on Broadcasting VC.

[Claim 8] The system according to claim 1 which the above-mentioned base station carries out rebroadcast of the above-mentioned IGMP message, and is characterized by resetting a timer in order for mobiles other than the mobile which sends out an IGMP message to prevent generating the further report so that a report of the format of the up link IGMP message to a base station may be transmitted on the unicast control VC, an Internet Group Mangement Protocol (IGMP)

may be extended and all mobiles may receive the above-mentioned IGMP message.

[Claim 9] The above-mentioned base station is a system according to claim 4 characterized by carrying out reclaim of the above VC, when a timer is used in the active state of VC for an activity judging and the above-mentioned timer carries out a time-out.

[Claim 10] The mobile which the above-mentioned base station broadcasts the above-mentioned mapping periodically, and the mobile which does not participate in a message discards the above-mentioned message in IP level, and participates in a message is a system according to claim 6 characterized by opening VC corresponding to the above-mentioned message.

[Claim 11] The above-mentioned broadcasting is a system according to claim 10 characterized by being sent out with an IGMP host membership enquiry (query) message.

[Claim 12] A data-link-control protocol (DLC) is a system characterized by sending out NACK with a bit map vector when a reception place loses a cel using a negative-acknowledge (NACK) method in the multicast flow system for transmitting multicast traffic through a wireless layer, or only when the above-mentioned reception place receives a breakage cel.

[Claim 13] It is the system according to claim 12 which is stored in a buffer until the above-mentioned timer carries out the time-out of the cel which the timer was used in order to avoid a deadlock, and was transmitted, and is characterized by clearing it after the above-mentioned timer carries out the time-out of the above-mentioned buffer.

[Claim 14] When loss is detected, it is the system according to claim 13 which a reception place maintains a reception place timer and is characterized by having the almost same time out value as the time out value of the timer used in order that the above-mentioned reception place timer may prevent a deadlock.

[Claim 15] The above-mentioned reception place is a system according to claim 14 characterized by requiring resending until the above-mentioned reception place timer carries out a time-out.

[Claim 16] It is the system according to claim 14 carried out [ sending out a subordinate ACK (check) message, after a transmitting agency has the subordinate Acknowledgement timer of the time out value connected to the above-mentioned reception place timer which has a half time out value mostly, it resets an Acknowledgement timer subordinate when the above-mentioned transmitting origin has data which should be transmitted and, as for the above-mentioned transmitting origin, the above-mentioned transmitting origin transmits the last group's cel and ] as the description.

[Claim 17] When the above-mentioned reception place receives an accompanying ACK message including the sequence number of a transmission cel, the above-mentioned reception place is a system according to claim 16 characterized by returning a NACK message when it judges whether cel loss arose and cel loss arises.

[Claim 18] The wireless ATM system by which VC space is characterized by being divided into Unicast VC, Broadcasting VC, and Multicast VC.

[Claim 19] A unicast IP address is a system according to claim 18 characterized by being mapped by the above-mentioned unicast VC.

[Claim 20] A multicast IP address is a system according to claim 18 characterized by being mapped by the above-mentioned multicast VC.

[Claim 21] A broadcasting IP address is a system according to claim 18 characterized by being mapped by the above-mentioned broadcasting VC.

[Claim 22] In the multicast group subscription approach for a mobile (a) Step which starts connection with a base station on a radio control channel (b) In the above-mentioned mobile The step which receives the response containing a broadcasting VC number and the unicast control VC number which the above-mentioned mobile should use, (c) The step which sends out an IGMP subscription message through the above-mentioned control VC, (d) The step which searches a base station database in order to investigate whether mapping of <a multicast group and VC number> exists, (e) If VC is taken out from available VC pool, mapping of <a multicast group and VC number> is created to Above VC and the above-mentioned mapping does not exist in step d Step which stores information in the above-mentioned database (f) When the above-mentioned mapping exists in step d Step which offers VC by which existing was mapped

(g) On Broadcasting VC Step which transmits <the multicast group address and VC number> to the above-mentioned mobile (h) Approach characterized by having the step which opens VC corresponding to mapping of the above <the multicast group address and VC number> for data reception.

[Claim 23] The above-mentioned approach is (i) further. The step which sends out a host membership query on the above-mentioned broadcasting VC, (j) The step which discards a message when a mobile does not belong to a multicast group, (k) The step which starts the report delay timer which has the time out value chosen at random when a mobile belongs to the above-mentioned multicast group who does correspondence, (l) The step which sends out a host membership report on the above-mentioned broadcasting VC if the above-mentioned timer carries out a time-out, (m) Step which carries out rebroadcast of the above-mentioned host membership report (n) Approach according to claim 22 characterized by having the step which resets a timer and does not generate a report when the rebroadcast of step m was received.

[Claim 24] In the multicast group balking approach for a mobile (a) The step which sends out an IGMP balking message to a base station using Control VC, (b) Step which decreases the value of the counter combined with corresponding VC (c) Step which confirms whether the above-mentioned counter reached zero (d) In step c The step which continues transmission on the above VC in step b when the above-mentioned counter does not reach zero, (e) Step which closes VC which corresponds to the above-mentioned mobile (f) Approach characterized by having the step which sends out a release message when all the counters became below zero.

[Claim 25] The approach characterized by having the step which maintains the database of all the mobiles relevant to the above-mentioned multicast group, and the step which maps the group of all mobiles which has joined the above-mentioned multicast group in a multicast group in the approach used in order to map a mobile in a multicast group and to delete the above-mentioned mobile from the above-mentioned multicast group.

[Claim 26] The approach which will be characterized by decreasing the value of the above-mentioned counter if the value of the above-mentioned counter is made to increase when it has the step which maps a multicast group in a counter in the approach used in order to map a mobile in a multicast group and to delete the above-mentioned mobile from the above-mentioned multicast group and a mobile joins the above-mentioned multicast group, and the above-mentioned mobile secedes from the above-mentioned multicast group.

[Claim 27] The approach characterized by having the step which presumes un-existing [ of a mobile ] suggestively in the approach used in order to map a mobile in a multicast group and to delete the above-mentioned mobile from the above-mentioned multicast group when a release message is sent out to the upstream.

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to a wireless Asynchronous Transfer Mode (ATM) network. Specifically, this invention relates to the approach of transmitting the packet formed on the wireless ATM network according to a different protocol especially from ATM, and the network system which transmits this packet about online communications and networking.

[0002]

[Description of the Prior Art] Since Wireless ATM is useful in order to offer broadband wireless service, researches and developments are done actively. About this wireless ATM, they are ATM Forum of a related organization, and ETSI (European Telecommunications Standards Institute). It is going to standardize. Conventionally, as a wireless ATM system, there is a WATM network and this WATM network is equipped with two main components, for example. That is, it has (a) fixed core network and the common wireless access link which extends (b) ATM cell transmission to a mobile host. About a WATM network, it is based on D.Raychaudhuri, L.J.French, R.J.Siracusa, S.KBiswas, R.Yuan, P.Narasimhan, and C.A.Johnston. "it is WATMnet : Please refer to A prototype wireless ATM system for multimedia personal communication" (IEEE Journ. Select. Areas Commun., January, 1997).

[0003] The other conventional wireless ATM systems are also twisted to D.Raychaudhuri, L.J.French, R.J.Siracusa, S.KBiswas, R.Yuan, P.Narasimhan, and C.A.Johnston. "WATMnet : It is indicated by A prototype wireless ATM system for multimedia personal communication" (IEEE Journ. Select. Areas Commun., January, 1997).

[0004] Furthermore, the technique of performing mobile communications using the conventional mobile ATM is described by A.Acharya, J.Li, B.Rajagopalan, and "Mobility management in wirelessATM networks" (IEEE Commun. Mag., 1997) by D.Raychaudhuri.

[0005] moreover, about preparing an Internet Protocol (IP) support in a core network Arup Acharya, Rajiv Dighe, Furquan It is based on Ansari. "[ IP ] switching over fast ATM cell transport (IPSOFAC TO): Switching multicast flows" (Proc.IEEEGlobecom, 1997), Arup Acharya, RajivDighe, "A frameworkfor IP switching over fast ATM celltransport (IPSOFAC TO)" (it SPIE(s) Proc. —) by Furquan Ansari It is indicated by the paper it is [ 1997 ] entitled.

[0006] The technique called IPoATM (IPoverATM) and IPSOFAC TO is indicated by the United States patent application 08th in coincidence \*\*\*\* by Acharya and others (ACHARIYA) who is the artificer of this invention / No. 771,559 (a correspondence Japan patent application number, Japanese Patent Application No. No. 350411 [ 09 to ]), and the United States patent application 09th in coincidence \*\*\*\* according to ACHARIYA and others similarly / No. 080 or 208 at the detail, and these are referred to also in this specification if needed.

[0007] Here, in order to make an understanding of this invention easy, the technique called IPSOFAC TO is explained.

[0008] IPSOFAC TO (IP Switching Over Fast ATM Cell Transport (IP switching in a high-speed ATM cell transfer)) is one mode of the approach of mapping IP flow on change-over pass (virtual connection) in the network of an ATM switch.

[0009] On the other hand, as the standard IPoATM technique, it is James, for example. V.Luciani,

"NBMA next hop resolution protocol (NHRP)" (it Draft(s) Internet [ ] —) by Dave Cole Katz and David Piscitello and Bruce J. draft-ietf-rolc-nhrp-13.txt, Work in Progress; Mark It is based on Laubach. "[ Classical ] IP and ATM ARP over " ( ) [ ATM ] Forum; In "Multiprotocol over ATM version 1.0 (baseline text version 16)" (ATM Forum) by Andre N. Fredette (editor) There is a technique currently outlined.

[0010] In order to set up the connection between end points, the above-mentioned technique of IPSOFACTO is the point of not using an ATM signaling stack, and differs from the standard IPoATM technique.

[0011] At IPSOFACTO, the new datagram of the beginning of IP flow sets up the connection between end points by hop BAIHOPPU, passing an ATM switch. Arup Acharya, Rajiv Dighe, Furquan IP switching over fast ATM cell transport "IPSO-FACTO by Ansari : " (it Draft(s) Internet [ ] —) jdraft-acharya-ipsw-fast-cell-00.txt, 1997; Arup Acharya, Rajiv Dighe, "A framework for IP switching over fast ATM cell transport (IPSOFACTO)" (it SPIE(s) Proc. —) by Furquan Ansari 1997; Arup Acharya, Rajiv Dighe, Furquan It is based on Ansari. "[ IP ] switching flows over fast ATM cell transport (IPSOFACTO): Switching multicast " (it Globecom(s) Proc. IEEE [ ] —) Please refer to 1997.

[0012] A. The actuation in the basic actuation IPSOFACTO of 1(a). IPSOFACTO is based on mapping IPSOFACTOVC in input port to either a switch control processor or an output port altogether. Here, the switch is equipped with VC for IPSOFACTO, ATM signaling, etc. VC which cannot be used for IPSOFACTO carried out by the ability not transmitting data does not exist. Intact VC in the input port of a switch is mapped by the switch control processor. The data transmitted using intact VC are always given to a controller, and this controller performs the conventional IP protocol stack containing required IP routing protocol.

[0013] Drawing 1 is for explaining the basic actuation of IPSOFACTO mentioned above. Each port of a switch constitutes IP interface. IP routing table of illustration used the output interface set as interfaces 2 and 3, respectively, and has specified the root to the destination networks 1.2 and 4.1.2. VC82 on the input-side port i is first mapped by the control processor.

[0014] The cell level change-over pass which transmits data in the above-mentioned system is set as follows. A transmitting agency chooses intact VC on an output link, and transmits the 1st packet of a new flow. This packet is received by the switch processor in the downstream of a link, next this switch processor chooses an output link based on that IP routing table. The selected output-link top is transmitted to this 1st packet by the processor by choosing intact VC on each link next.

[0015] In the example shown in drawing 1, the upstream router has chosen VC82, in order to exchange a new flow. The 1st packet of this flow is received by the illustrated router, next this router investigates IP routing table, and an output interface is chosen (in this case, 3). On an interface 3, in order to transmit a packet to the router of the downstream, VC51 is chosen. Since the switch control processor has all information <input port, Input VC, an output port, and an output VC> required in order to switch a flow, it adds an entry in a switch VC table. It is exchanged in all consecutiveness cells. At this time, the transmission by future packet levels becomes unnecessary with a control processor.

[0016] Unlike the data packet exchanged on cell level, the change-over pass for IP control messages is not formed. Usually, a control message is sent out and received on the control VC defined beforehand. Therefore, such a control message is transmitted through all switch control processors. This mechanism is used in order to set up the transfer condition for every flow. For example, the change in a transfer condition, such as separating an output interface, is used in order to change change-over pass (for example, <an out side port and VC> are deleted from VC table). If a control processor is canceled of a transfer condition, corresponding change-over pass will be released by marking an input and an output VC as intact.

[0017] B. The wireless ATM structure of a system of the wireless ATM system former is shown in drawing 2. It enables it to connect a base station to a mobile terminal through a radio link in such network architecture. Furthermore, the base station is connected to the core network through the cable link. Cell exchange is carried out in a base station, and the data from a cable interface to a wireless interface are TDMA (Time Division Multiple Access). Within a frame, an

ATM cell is transmitted to a mobile terminal through a radio link. Thereby, ATM connection between end to end is made. By each base station, the mobile of the number of predetermined numbers can be supported in the domain.

[0018] It is used for wireless access of dynamic TDMA / TDD (Time Division Duplexing) ( drawing 3 ) protocol using centralized control on a WATM link. Control information and the down link (down link) information from the base station containing an ATM cell are multiplexed by single burst, and are transmitted to the head of the TDMA frame following a preamble and a frame header. A base station controls the slot allocation to a mobile [ in an up link (above link) ]. up link control information — a bandwidth allocation demand — containing — ALOHA contention mode — a slot — it is-izing and sent out. The detail of a TDMA/TDD frame format is indicated by "Design and Performance of radio access protocol in WATMnet, a prototype wireless ATM network" (Proc. ICUPC, 1997) by P.Narasimhan, S.KBiswas, C.A.Johnston, R.J.Siracusa, and H.Kim.

[0019] About IPSOFACTO, I hear that it is received by the wireless layer in all mobile terminals, and an important thing has all the cells on a downlink burst. However, DLC to the terminal which filtered the receiving cell based on VC number by the MAC (Media Access Control) layer in each mobile terminal, and was beforehand opened by VC (Data Link Control) A cell is transmitted to a layer. Up link transmission is performed to a point-to-point, and a cell is transmitted to a base station through each slot from a terminal. In the MAC layer in a base station, only when corresponding VC is already opened, a cell is transmitted to a DLC layer. The space currently assigned to VC in both directions is common to all mobile terminals. In the case of the conventional wireless ATM system, although an access link is shared among all mobiles, the control VC according to individual is used to each mobile.

[0020] B.1. It is calling it multicasting to transmit an IP packet to a host's subset on a background network. As main advantages of multicasting, in case a packet is sent out to the group of a reception place, it is raised that the overhead in a network and a host is low. It is reserved for multicast actuation of the class D address of IP (IPv4) address space (from 224.0.0.0 to 239.255.255.255). A multicast address does not specify a certain IP interface in the Internet, and specifies [ instead ] the interface group. The multicast is fully supported by Local Area Networks, such as Ethernet equipped with efficient broadcasting distribution and large-scale multicast address space.

[0021] With the filter of the hardware level in a Network Interface Card, non-wanted datagram is removed, before reaching IP layer. In order to operate a hardware filter, the IP multicast group destination must be changed into the link layer multicast address which can be recognized by network hardware in a network interface. In fact, when 27 bits of the low order of IP multicast address are mapped by 23 bits of the backmost part of the Ethernet address, an Ethernet multicast address is created. About this conversion, it is Gary. R.Wright and W.Richard It is based on Stevens. "TCP/IP illustrated, Volume 1 : Please refer to The protocols" (Addisison-Wesly Publishing Co., Reading, Massachusetts, 1995). Furthermore, in a network, in order to copy a packet and to transmit to two or more destinations in a network, a multicast routing protocol is needed.

[0022] B.2. The multicast actuation on the point-to-point link using the multicast IPSOFACTO on a point-to-point link is also comparatively easy. In TOSURU of the transmitting cache entry will be carried out into a multicast transmitting cache by the 1st IP packet of the multicast flow which arrives at a switch controller. VC number and the port number (chosen by the upstream switch controller) of an arrival packet are obtained. Furthermore, about each output interface in the newly created multicast transmitting cache, IPSOFACTO chooses intact VC and transmits a packet to a downstream switch controller. Next, the entry of input port and the input VC is carried out to an output port and the switch hardware VC table corresponding to mapping on the list of outputs VC. All the consecutiveness packets within a flow are switched on cell level using the hardware multicast function of ATM switching structure.

[0023] B.3. The multicast on a WATM link : some new problems arise in the multicast on the definition share wireless access link in question. The link which can be set in this case logically produces one of the problems of these by being broadcasting in a down link and being a unicast

in an up link. When performing a multicast to a group with a mobile, it is necessary to map IP multicast address to the link layer address like Ethernet. The mobile which does not belong to a multicast group is a hardware level, and needs to remove non-wanted data suitably. (Wireless) The link layer identifier for ATM is a virtual channel (VC) number. It is necessary to map IP multicast address for VC number in order to attain the result of a request.

[0024] I hear that another trouble in a wireless ATM system needs to improve the activation throughput in a transport layer, and there is. Since the bit error rate (BER) of a radio link is very higher than the bit error rate of a fixed ATM network, the error restoration mechanism of the cel level which prevents the fall of a packet level throughput is needed. The cel level restoration mechanism over the traffic class from which a unicast connection differs is discussed by "Data link control protocols for wireless ATM accesschannels" (Proc. ICUPC, 1995) by H.Xie, P.Narasimhan, R.Yuan, and D.Raychaudhuri. Since an IP multicast flow is mapped in Multicast VC (UBR), a cel level error restoration (and cel sequencing) mechanism must be extended so that two or more reception places can be treated.

[0025]

[Problem(s) to be Solved by the Invention] There are the following problems in the conventional approach at least.

[0026] - By the conventional approach, the wireless ATM link to a mobile terminal cannot be treated. Thus, it is indispensable to enable it to treat a wireless ATM link in order to fully realize potential capacity of a conventional technique like IPSOFACTO.

[0027] - The Internet Group Mangement Protocol (IGMP) is inadequate as stated to "Internet group management protocol, version 2" (Internet Working Group Request for Comments 2236 months, November, 1997) by W.Fenner. For this reason, effective amelioration and technique are required rather than it decreases the unnecessary multicast traffic between a base station and a mobile.

[0028] - The cel level error restoration mechanism is inadequate for treating two or more reception places.

[0029] The purpose of this invention is offering multicasting on the wireless ATM link to a mobile terminal, and solving the above-mentioned problem.

[0030]

[Means for Solving the Problem] In order to realize the above-mentioned purpose, it has the protocol with which it was beforehand set for transmitting a packet flow to the destination through an ATM network in this invention. In the network system equipped with the node which has the source, and the router and ATM switch for transmitting an ATM cel sequence using an intact virtual channel identifier (VCI) The above-mentioned router relates one of two or more of the output ports with the above-mentioned intact VCI, without performing signaling by hop BAIHOPPU. By this When change-over pass is set and, as for the above-mentioned ATM switch, each of the above-mentioned ATM cel has the same VCI as the above-mentioned intact VCI An ATM cel is transmitted through the above-mentioned one among two or more above-mentioned output ports, without being based on control of the above-mentioned router. A multicast virtual channel (VC) the address corresponding to an IP multicast group It is obtained by mapping for VC number corresponding to the above-mentioned multicast VC, and the system characterized by at least one base station giving VC number to the new mobile which joins one of the above-mentioned IP multicast groups using the above-mentioned mapping is obtained.

[0031] The system by which a base station is characterized by determining the correspondence relation between VC and a mobile in the above-mentioned system as the above-mentioned amelioration is obtained. Moreover, in the further amelioration, the system characterized by building beforehand the congruence directional control VC for transmitting the control message between the unidirectional broadcasting VC to a mobile from the above-mentioned base station, the above-mentioned base station, and the above-mentioned mobile is obtained in the above-mentioned system.

[0032] Preferably, the control protocol between the above-mentioned base station and a mobile is VC. REQUEST and VC It has a RECLAIM control message and is Above VC. In order to require VC which should send out data of the above-mentioned base station, it is used by the



mobile, and a REQUEST message is Above VC. A RECLAIM message is used by the base station in order to carry out reclaim of the VC assigned to the above-mentioned mobile.

[0033] The system characterized by carrying out reclaim of the above VC in the above-mentioned system as the further amelioration if the above-mentioned base station uses a timer in VC active state for an activity judging and the above-mentioned timer expires is obtained.

[0034] As still more nearly another amelioration, in the above-mentioned system, the above-mentioned base station detects a packet boundary, and the system characterized by the ability to merge two or more flows in one VC is obtained.

[0035] As still more nearly another amelioration, the system characterized by the above-mentioned base station maintaining a transmitting agency IP address, the multicast group address, and the mapping relation between VC numbers is obtained in the above-mentioned system.

[0036] Preferably, the above-mentioned base station broadcasts the above-mentioned mapping periodically, the mobile which does not participate in a message discards the above-mentioned message in IP level, and the mobile which participates in a message opens VC corresponding to the above-mentioned message. The above-mentioned broadcasting is more preferably sent out with an IGMP host membership enquiry (query) message.

[0037] As still more nearly another amelioration, an Internet Group Management Protocol (IGMP) is extended, a multicast mobile receives the above-mentioned IGMP message, and generates a suitable report, and the system characterized by a non-multicast mobile abandoning the above-mentioned IGMP message in IP level is obtained so that enquiry in the format of a down link IGMP message may be transmitted on Broadcasting VC in the above-mentioned system.

[0038] As still more nearly another amelioration, in the above-mentioned system, so that a report of the format of an up link IGMP message may be transmitted on the unicast control VC So that an Internet Group Management Protocol (IGMP) may be extended and all mobiles may receive the above-mentioned IGMP message The above-mentioned base station carries out rebroadcast of the above-mentioned IGMP message, and in order for mobiles other than the mobile which sends out an IGMP message to prevent generating the further report, the system characterized by resetting a timer is obtained.

[0039] another voice of this invention — if it depends like, in the multicast flow system for transmitting multicast traffic through a wireless layer, the system characterized by a data-link-control protocol (DLC) sending out NACK with a bit map vector when a reception place loses a cel using a negative-acknowledge (NACK) method, or only when the above-mentioned reception place receives a breakage cel will be obtained.

[0040] The system characterized by storing it in a buffer until the above-mentioned timer completes the cel which the timer was used in order to avoid a deadlock in the above-mentioned system, and was transmitted, and clearing it as still more nearly another amelioration after the above-mentioned timer completes the above-mentioned buffer is obtained.

[0041] Preferably, when loss is detected, a reception place maintains a reception place timer and the above-mentioned reception place timer has the almost same time out value as the time out value of the timer used in order to prevent a deadlock. Still more preferably, it requires resending until the above-mentioned reception place timer completes the above-mentioned reception place.

[0042] As the further amelioration, a transmitting agency has the accompanying Acknowledgement timer of the time out value connected to the above-mentioned reception place timer which has a half time out value mostly in the above-mentioned system. The above-mentioned transmitting origin resets an accompanying Acknowledgement timer when there are further data which should be transmitted, and the system characterized by the above-mentioned transmitting origin sending out an accompanying ACK message after the above-mentioned transmitting origin transmits the last group's cel is obtained. If the above-mentioned reception place receives an accompanying ACK message including the sequence number of a transmission cel preferably, it will judge whether cel loss produced the above-mentioned reception place, and the NACK message which shows that cel loss arose will be returned.

[0043] According to another mode of this invention, in a wireless ATM system, the system by

which VC space is characterized by being divided into Unicast VC, Broadcasting VC, and Multicast VC is obtained. As the further amelioration, the system characterized by a unicast IP address being mapped by the above-mentioned unicast VC is obtained in the above-mentioned system.

[0044] As still more nearly another amelioration, the system characterized by a multicast IP address being mapped by the above-mentioned multicast VC is obtained in the above-mentioned system.

[0045] As still more nearly another amelioration, the system characterized by a broadcasting IP address being mapped by the above-mentioned broadcasting VC is obtained in the above-mentioned system.

[0046] According to another mode of this invention, it sets to the multicast group subscription approach for a mobile. In the step which starts connection with a base station on a radio control channel, and the above-mentioned mobile The step which receives the response containing a broadcasting VC number and the unicast control VC number which the above-mentioned mobile should use, The step which sends out an IGMP subscription message on the above-mentioned control VC, and the step which searches a base station database in order to investigate whether mapping of <a group and VC number> exists, If VC is taken out from available VC pool, mapping of <a multicast group and VC number> is created to Above VC and the above-mentioned mapping does not exist The step which stores information in the above-mentioned database, and when the above-mentioned mapping exists The step which offers VC by which existing was mapped, and on Broadcasting VC The approach characterized by having the step which transmits <the group address and VC number> to the above-mentioned mobile, and the step which opens VC corresponding to mapping of the above <the multicast group address and VC number> for data reception is acquired.

[0047] As the further amelioration, it sets to the above-mentioned approach. The above-mentioned approach Furthermore, the step which sends out host membership enquiry (query) on the above-mentioned broadcasting VC, The step which discards a message when a mobile does not belong to a multicast group, The step which starts the report delay timer which has the expiration value chosen at random when a mobile belongs to the above-mentioned multicast group who does correspondence, The step which sends out a host membership report on the above-mentioned broadcasting VC if the above-mentioned timer carries out a time-out, The approach characterized by having the step which carries out rebroadcast of the above-mentioned host membership report, and the step which will reset a timer and will not generate a report if rebroadcast is received is acquired.

[0048] As another mode of this invention, it sets to the multicast group balking approach for a mobile. The step which sends out an IGMP balking message to a base station using Control VC, The step which decreases the value of the counter combined with corresponding VC, and the step which confirms whether the above-mentioned counter reached zero, When the above-mentioned counter does not reach zero, the approach characterized by the step which continues transmission on Above VC, the step which closes VC which corresponds to the above-mentioned mobile, and having sending out a discharge message when all the counters became below zero is acquired.

[0049] In the approach used in order to map a mobile in a multicast group and to delete the above-mentioned mobile from the above-mentioned multicast group as another mode of this invention, the approach characterized by having the step which maintains the database of all the mobiles relevant to the above-mentioned multicast group, and the step which maps the group of all mobiles which has joined the above-mentioned multicast group in a multicast group is acquired.

[0050] still more nearly another voice of this invention — if it depends like, when it has the step which maps a multicast group in a counter in the approach used in order to map a mobile in a multicast group and to delete the above-mentioned mobile from the above-mentioned multicast group and a mobile will join the above-mentioned multicast group, make the value of the above-mentioned counter increase, and if the above-mentioned mobile secedes from the above-mentioned multicast group, the approach characterized by to decrease the value of the above-

mentioned counter will be acquired.

[0051] moreover, another voice of this invention — if it depends like, when existence of a mobile is suggestively presumed from a multicast outing protocol and the mobile is not related with the multicast group in the approach used in order to map a mobile in a multicast group and to delete the above-mentioned mobile from the above-mentioned multicast group, the approach characterized by a release message sending out to the upstream is acquired.

[0052]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained to a detail with reference to a drawing.

[0053] The desirable example of this invention extends the IPSOFACTO system currently explained to the detail in the United States patent application 08th by ACHARIYA and others who is the artificer of this invention / No. 771,559 (Japanese Patent Application No. No. 350411 [ 09 to ]), and the United States patent application 09th / No. 080 or 208. The capacity which chooses intact VC to new IP flow as an important element in the conventional IPSOFACTO is improved. Since it points only to the terminal/switch which all intact VC has in the other end of a link in a bidirectional point-to-point link, it can choose easily.

[0054] On the other hand, the wireless ATM link in a WATM network system is supporting two or more mobile terminals. Such a radio link has the broadcasting down link and the unicast up link. About this point, it is based on D.Raychaudhuri, L.J.French, R.J.Siracusa, S.KBiswas, R.Yuan, P.Narasimhan, and C.A.Johnston. "it is WATMnet. : Please refer to A prototype wirelessATM system for multimedia personalcommunication" (IEEE Journ. Select. Areas Commun., 1997 years).

[0055] A. Escape to WATM of IPSOFACTO: In order to support a different traffic type according to IPSOFACTO+W this invention, it is IPSOFACTO on a radio link. VC is classified into NIKYASUTO VC, Multicast VC, and Broadcasting VC. The data transmitted by Unicast VC are received by only one mobile. Similarly, the data transmitted by Broadcasting VC are received by all mobiles. On the other hand, the data transmitted on Multicast VC are received by only the group with a mobile.

[0056] Multicast VC is obtained by mapping the IP multicast group address for VC number. Such mapping is performed when a mobile joins a multicast group first. Also when joining the IP multicast group with other same mobiles by this mapping of <the IP multicast group address and VC>, a base station gives the VC number concerned. Mapping of 1 to 1 is maintained between VC and the IP multicast group address.

[0057] In order to perform multicast actuation appropriately for the asymmetry of a wireless ATM access link, it is required to correct an IPSOFACTO protocol. Since the same VC space is used by all the mobiles in a predetermined base station, VC cannot be beforehand prepared because of data reception. The control protocol between a base station and a mobile is used, and VC which a mobile should use by the base station is determined in such a control protocol.

[0058] Here, in order to support unicast traffic, such a control protocol is not sometimes required. This is because VC space is divided and it is assigned to each mobile, without producing contention. Division of VC space is not performed at the time of multicasting. This is because a mobile can join and/or break away dynamically at a multicast session.

[0059] On a WATM terminal, when IPSOFACTO is set up, the following VC is given beforehand.

[0060] – One direction broadcasting VC to a mobile from a base station.

[0061] – Bidirectional unicast control VC between a base station and a mobile. Since a control message is sent out, these control VC is used.

[0062] The control protocol between a base station and a mobile is VC. REQUEST and VC The RECLAIM control message is included. VC A REQUEST message is used by the mobile, in order to require of a base station so that VC which transmits data may be given. VC A RECLAIM message is used by the base station and used for carrying out reclaim of the VC given to the mobile. A base station is usually VC, when a timer is used in order to judge VC active state, and a timer carries out a time-out (i.e., if it will not be in an active state on the VC). RECLAIM is sent out.

[0063] When two or more transmitting origin exists in the same multicast group, other special

features are incorporated. When the same VC is used to the multicast group irrespective of the number of transmitting agencies, the boundary of a packet (frame) is detected and the base station which can merge two or more flows into one VC is needed. When the base station in which such VC merge is possible cannot be used, different VC to each transmitting origin in a multicast group is used. In such a case, a base station maintains mapping of <a transmitting agency IP address, the multicast group address, and VC#>. This means that each mobile opens two or more VC to current and the same IP multicast group.

[0064] In order to improve dependability, a base station broadcasts mapping periodically. Such broadcasting is usually sent out with an IGMP host membership enquiry (query) message. The mobile which does not participate in this message only discards a message in IP level. It is useful to have mapping of <the source (transmitting agency), a group, and VC>, when a reception place uses IGMPv3 which can choose multicast traffic and can receive only from the set of specific transmitting origin. The mobile which participates in the set of specific transmitting origin should just open the corresponding reception VC.

[0065] B. Escape of IGMP: According to IGMP+W this invention, to an Internet Group Management Protocol (IGMP), modification and correction are added so that it can operate within the wireless ATM environment. IGMP is used by IP host in order to report host group member cypridium conventionally to the multicast router which adjoins directly. In a wireless ATM system, the base station itself may be a multicast router, or the conventional IP router may be the alternative which can operate as different hop.

(hop=passage of a data packet between two network nodes(for example, between two routers)  
proxy=Entity that, in the interest of efficiency, essentially stands in for another entity <- from the Internet data)

Below, the case where the base station itself is a multicast router is explained.

[0066] A multicast router sends out a host member cypridium enquiry (query) message, in order to find out whether it has the member on the local network to which which host group is connected. It is taken out by all hosts' group (address 224.0.0.1), and enquiry (query) is IP. TTL (time to live [Time-To-Live] duration) = 1 It is transmitted by making it [(Field in an IP header that indicates how long a packet is considered valid.)]. By creating a host member cypridium report, a host answers enquiry (query) and reports each host group to whom self belongs on the network interface which received enquiry (query). In order to avoid the congestion by the concurrence of a report and to reduce the total of the report transmitted, two technique is used in the conventional IGMP.

[0067] 1. Choose a delay timer value at random. The response to enquiry (query) is generated at the time of the time-out of a timer. This is useful to distributing a response in time.

[0068] 2. A response report is taken out to the host group address, where TTL is set as 1. Other members of a group same on the same network can see the report, and can control that another report is created to the group. The load of IGMP can be decreased by this.

[0069] In order to attain the same actuation on a wireless ATM system, in this invention, following modification/escapes are performed to IGMP.

[0070] 1. A down link IGMP message (query) is transmitted on Broadcasting VC (from a base station to a mobile). The mobile (host) in which all multicasting is possible receives IGMP and a query message, and creates a suitable report. Although the mobile which cannot be multicasted can also receive these messages, these messages are discarded in IP level.

[0071] 2. An up link IGMP message (report) is transmitted on the same unicast control VC. If this report is received, since a base station will carry out rebroadcast of the report, other mobiles can receive the report created by the host (mobile) belonging to a multicast group. When another host is the same group's member, the timer is reset and it is made to refrain from creation of another report.

[0072] C. subscription in the multicast group of a new mobile, or balking — explain the step which performs multicast actuation at the time of a mobile newly joining the wireless ATM system concerning a desirable operation gestalt. In drawing 2, M1, M2, and M3 are three mobiles connected a base station and now. Mobiles M1 and M2 join a multicast group, 225.1.1.1 [ for example, ], multicast data are received, and the case where it finally secedes from a group is

explained.

[0073] A base station needs to determine the stage when mapping should be added from a database, and the stage which should be deleted so that a mobile can join or break away proper. It is comparatively easy to add a new entry. When a mobile joins a multicast group and this group's mapping does not exist yet in a database, an entry is newly added. However, if the stage when an entry should be deleted is determined from a database, a base station needs to confirm that the mobile station connected with the specific multicast group address concerned does not exist. In order to acquire such information, a base station can maintain a mapping database by three different approaches.

[0074] 1. Map the list of mobile IP addresses which join a source (transmitting agency) IP address, i.e., <the multicast group address and VC number>, and this group.

[0075] 2. Map a source (transmitting agency) IP address, <the multicast group address and VC number>, and a counter (or flag).

[0076] 3. Map a source (transmitting agency) IP address, and <the multicast group address and VC number>.

[0077] In the 1st case, a database with all the perfect mobiles relevant to a multicast group will be held. Maintenance of a database will be complicated although great flexible SHIBIRITI and functionality are acquired by having perfect mapping.

[0078] What is necessary is just to count up a base station, when a mobile joins a group, and to hold the counter counted down when seceding from a group in the 2nd case. If all mobiles secede from a group, a counter becomes zero and can delete an entry from a group safely. Here, there is not even need of continuing supervising how many mobiles being connected with the group address now. What is necessary is just to use the flag (a condition 0 and condition 1) set as zero (reset), when it is set as 1 and a mobile does not exist, as long as at least one mobile exists.

[0079] In the 3rd case, the information about the mobile connected with the specific multicast group address existing can be suggestively presumed from a multicast roux TIGU protocol. When the mobile is not connected with a multicast group, a base station (it is also a multicast router) sends out a discharge message to an upstream router, in order to separate the multicast traffic to the group. This message is generated by the multicast routing protocol only when there is no host (mobile) connected with that multicast group. This message can be used as a trigger for deleting the entry from a database.

[0080] An assumption of a two or more-IGMPv protocol performs the following operating sequences.

[0081] - If it goes into the area (it is usually called a cel) where a mobile is controlled by the base station, connection actuation with a base station will be started through a radio control channel. This is the communication link mechanism of wireless level.

[0082] - A base station answers by giving a broadcasting VC number and the unicast control VC number which a mobile should use with other information.

[0083] - A mobile M1 determines to join the IP multicast group 225.1.1.1, and transmits an IGMP subscription message on Control VC. When using a PIM[Personal Information manager] DENSU (dense) mode multicast routing protocol, a graft (Graft) message is created by the base station and it is sent out to the router of the upstream.

[0084] - Next, a base station searches the database and investigates whether mapping of <a group and VC number> exists. In not existing, a base station chooses VC from the pool of available VC, maps this VC to the multicast group address, and stores information in a database. This information (<the group address, VC number>) is transmitted to a mobile through Broadcasting VC.

[0085] - if this mapping is received, a mobile opens predetermined VC for data reception. Here, other mobiles which received this information only discard this.

[0086] - Decision of joining the group (225.1.1.1) with the same mobile M2 sends out a subscription message to a base station. A base station's reception of this message searches a database in search of <group and VC> mapping. Since such mapping already exists, the same VC number is given to a mobile. A mobile M2 opens this VC for data reception.

[0087] - A base station sends out a host member cypridium query on Broadcasting VC (255) periodically. Hosts other than M1 and M2 will discard this message. If M1 and M2 receive this message, these mobiles will start the report delay timer with which the time out value was chosen at random. In order that a host may reduce the probability which chooses the same delay value, it is RFC (Request For Comment). It is recommended as some seeds then for pseudo-random number generators that a host's own IP address is used. Gary R.Wright and W.Richard It is based on Stevens. "TCP/IP illustrate, Volume 1 : Please refer to The Protocols" (Addison-Wesley Publishing Company, Reading, Massachusetts, 1995).

[0088] - If a timer carries out a time-out by one mobile, a host member cypridium report will be created and it will be sent out on Broadcasting VC. A base station receives and broadcasts this message (\*\*). If other mobiles receive this message, that timer will be reset and a report will not be created.

[0089] - A base station transmits multicast data to the group (225.1.1.1) of VC obtained from <group and VC> mapping. Since VC same for reception of both mobiles M1 and M2 is opened, both receive multicast data. All other mobiles discard this data.

[0090] - IGMP balking actuation is performed similarly.

[0091] D. Explain the desirable operation gestalt of the data-link-control (DLC) protocol for transmitting multicast traffic through the data-link-control wireless (physical) link for a multicast flow below. Such a protocol decreases a cel error rate and performs sequential cel distribution which can obtain a high throughput in a transport layer. It is shown by by using a data-link-control protocol that the effectual throughput of unicast traffic is improvable. P. Narasimhan, S.KBiswas, C.A.Johnston, R. J.Siracusa, H. "Design and by Kim performance ofradio access protocol in WATMnet aprototype wireless ATM network" (Proc.ICUPC, 1997) and H.Xie, P. — "Data link control protocols for wireless ATM access channels" (it ICUPC(s) Proc. [ ] —) by Narasimhan, R.Yuan, and D.Raychaudhuri Please refer to 1995.

[0092] IP multicast traffic is based on UDP (User Datagram Protocol), and although packet loss is not related, if restoration is performed on cel level, an activation throughput will improve sharply. Even if one of the ATM cels loses the improvement of such a throughput, the whole UDP datagram is treated as a code error in breakage and CRC (Cyclic Redundancy Check) of a packet, and it originates in being discarded. By restoring the lost cel, the whole packet can be restored and the total throughput of a transport layer can be raised.

[0093] The positive (it is affirmative) group check method is used for the data-link-control protocol for unicast flows to error restoration. A reception place sends out the group check packet equipped with the bit map vector which shows the error condition of the received cel. If the check packet concerned is received, a transmitting agency will analyze a bit map vector and will resend the lost cel alternatively. However, a transmitting agency will be burdened with the burden for check traffic when the mechanism for such multicast traffic is used. In order to avoid such a situation, only when the cel which the negative-acknowledge (NACK) method was used, and the cel lost in this case, or was damaged is received, NACK is sent out with a bit map vector from a reception place ( drawing 4 ). If a negative-acknowledge packet is received, a transmitting agency will perform an alternative resending algorithm in order to restore an error cel. Here, DLC activation is performed in the mode for every VC, and it needs for both a base and a terminal to hold the DLC status information according to individual for every VC. Furthermore, since a base station can distinguish Unicast VC and Multicast VC, it recognizes the right mechanism (ACK or NACK base) which should be used for error restoration.

[0094] Many mobiles belong to the same multicast group, and when operating by the basis in the conditions (phasing etc.) that various errors tend to occur, a burden called the repeat of a resending demand may be placed on a base station. In this case, in order to add the load which answers a resending demand, in a base station, there is a possibility that it may become impossible to transmit new multicast data. According to this invention, a timer is used in order to prevent a deadlock arising. It is put in by the buffer until a timer carries out the time-out of the transmitted cel, and a buffer is cleared after a time-out ( drawing 6 R> 6). A reception place requires resending of the cel which is due to be received, unless a transmitting agency timer carries out a time-out. All resending demands will be discarded if a transmitting agency timer

carries out a time-out. A reception place maintains an own timer. This timer will be started if cel loss is detected. The time out value of this timer is almost the same as the time out value of a transmitting agency timer. Unless a reception place timer carries out the time-out of the reception place, cel resending is required, and a reception place does not require resending any longer about the group's cel after a time-out, assuming that data were lost. This is the need. Although a transmitting agency does not answer the flume in which the timer carries out a time-out, or the resending demand which it becomes by this, either, a reception place can prevent sending out the demand of resending of the lost cel continuously and vainly.

[0095] The transmitting agency has the additional timer with a time out value equal to the abbreviation one half of the time out value of a resend timer. when the time-out of this timer is carried out, it is subordinate — [gratuitous] — since an Acknowledgement is sent out, it is used. This is useful, when the cel which should be transmitted does not remain any more, or when a long gap is in a data stream. When the mechanism of the NACK base is used for error restoration, the method of telling a reception place about the cel having been transmitted is needed. Usually, when there are data to transmit further, a transmitting agency resets a subordinate Acknowledgement timer. This is because it is shown by the reception place that a previous group's cel was lost by reception of a consecutiveness cel. A reception place creates the suitable NACK packet equipped with the right bit map vector for restoring the lost cel. Nevertheless, cel loss may not be detected by the reception place when a transmitting agency transmits the last group's (or group before a long gap) cel. This is because it does not turn out at all that the cel was transmitted. In such a case, a transmitting agency sends out the subordinate acknowledgement message which shows that a group's cel was transmitted. If a subordinate acknowledgement message including the sequence number of the cel to which the reception place was transmitted is received, it can judge whether cel loss arose and a letter can be answered in a NACK display. Before a resend timer carries out the time-out of the reason of having a smaller time out value here, it is for giving a chance creating NACK and restoring a loss cel to a reception place.

[0096] In this invention, the mechanism for offering an IP multicast to a wireless ATM system is acquired. VC is classified into Unicast VC, Multicast VC, and Broadcasting VC in order to distinguish a different traffic type. The control protocol between a base station and a mobile is used in order to give the suitable multicast VC number used when joining a specific IP multicast group to a mobile. Warm modification/escape to the IGMP protocol especially used in a wireless ATM system are obtained. In order to raise the effectual throughput in a transport layer at the last, the data-link-control protocol which has a negative acknowledge was explained to it.

[0097] If it is this contractor, modification and deformation of others of this invention will be clear from the above-mentioned explanation. That is, although this invention was explained only about some examples, it cannot be overemphasized that much modification is possible, without deviating from the meaning and the range of this invention.

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[Translation done.]

**\* NOTICES \***

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- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

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**TECHNICAL FIELD**

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[Field of the Invention] This invention relates to a wireless Asynchronous Transfer Mode (ATM) network. Specifically, this invention relates to the approach of transmitting the packet formed on the wireless ATM network according to a different protocol especially from ATM, and the network system which transmits this packet about online communications and networking.

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[Translation done.]



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 PRIOR ART
 

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[Description of the Prior Art] Since Wireless ATM is useful in order to offer broadband wireless service, researches and developments are done actively. About this wireless ATM, they are ATM Forum of a related organization, and ETSI (European Telecommunications Standards Institute). It is going to standardize. Conventionally, as a wireless ATM system, there is a WATM network and this WATM network is equipped with two main components, for example. That is, it has (a) fixed core network and the common wireless access link which extends (b) ATM cell transmission to a mobile host. About a WATM network, it is based on D.Raychaudhuri, L.J.French, R.J.Siracusa, S.KBiswas, R.Yuan, P.Narasimhan, and C.A.Johnston. "it is WATMnet : Please refer to A prototype wireless ATM system for multimedia personal communication" (IEEE Journ. Select. Areas Commun., January, 1997).

[0003] The other conventional wireless ATM systems are also twisted to D.Raychaudhuri, L.J.French, R.J.Siracusa, S.KBiswas, R.Yuan, P.Narasimhan, and C.A.Johnston. "WATMnet : It is indicated by A prototype wireless ATM system for multimedia personal communication" (IEEE Journ. Select. Areas Commun., January, 1997).

[0004] Furthermore, the technique of performing mobile communications using the conventional mobile ATM is described by A.Acharya, J.Li, B.Rajagopalan, and "Mobility management in wireless ATM networks" (IEEE Commun. Mag., 1997) by D.Raychaudhuri.

[0005] moreover, about preparing an Internet Protocol (IP) support in a core network Arup Acharya, Rajiv Dighe, Furquan It is based on Ansari. "[ IP ] switching over fast ATM cell transport (IPSOFAC TO): Switching multicast flows" (Proc.IEEEGlobecom, 1997), Arup Acharya, RajivDighe, "A frameworkfor IP switching over fast ATM celltransport (IPSOFAC TO)" (it SPIE(s) Proc. —) by Furquan Ansari It is indicated by the paper it is [ 1997 ] entitled.

[0006] The technique called IPoATM (IPoverATM) and IPSOFAC TO is indicated by the United States patent application 08th in coincidence \*\*\*\* by Acharya and others (ACHARIYA) who is the artificer of this invention / No. 771,559 (a correspondence Japan patent application number, Japanese Patent Application No. No. 350411 [ 09 to ]), and the United States patent application 09th in coincidence \*\*\*\* according to ACHARIYA and others similarly / No. 080 or 208 at the detail, and these are referred to also in this specification if needed.

[0007] Here, in order to make an understanding of this invention easy, the technique called IPSOFAC TO is explained.

[0008] IPSOFAC TO (IP Switching Over Fast ATM Cell Transport (IP switching in a high-speed ATM cell transfer)) is one mode of the approach of mapping IP flow on change-over pass (virtual connection) in the network of an ATM switch.

[0009] On the other hand, as the standard IPoATM technique, it is James, for example. V.Luciani, "NBMA next hop resolution protocol (NHRP)" (it Draft(s) Internet [ ] —) by Dave Cole Katz and David Piscitello and Bruce jdraft-ietf-rolc-nhrp-13.txtj, Work in Progress; Mark It is based on Laubach. "[ Classical ] IPand ATM ARP over " ( ) [ ATM ] Forum; In "Multiprotocol overATM version 1.0 (baseline text version 16)" (ATM Forum) by AndreN.Fredette (editor) There is a technique currently outlined.

[0010] In order to set up the connection between end points, the above-mentioned technique of IPSOFAC TO is the point of not using an ATM signaling stack, and differs from the standard

IPoATM technique.

[0011] At IPSOFACTO, the new datagram of the beginning of IP flow sets up the connection between end points by hop BAIHOPPU, passing an ATM switch. Arup Acharya, Rajiv Dighe, Furquan IP switching over fast ATM cell transport "IPSO-FACTO by Ansari:" (it Draft(s) Internet [ ] —) jdraft-acharya-ipsw-fast-cell-00.txtj, 1997; Arup Acharya, Rajiv Dighe, "A framework for IP switching over fast ATM cell transport (IPSOFACTO)" (it SPIE(s) Proc. —) by Furquan Ansari 1997; Arup Acharya, Rajiv Dighe, Furquan It is based on Ansari. "[ IP ] switching flows over fast ATM cell transport (IPSOFACTO): Switching multicast " (it Globecom(s) Proc.IEEE [ ] —) Please refer to 1997.

[0012] A. The actuation in the basic actuation IPSOFACTO of 1(a).IPSOFACTO is based on mapping IPSOFACTOVC in input port to either a switch control processor or an output port altogether. Here, the switch is equipped with VC for IPSOFACTO, ATM signaling, etc. VC which cannot be used for IPSOFACTO carried out by the ability not transmitting data does not exist. Intact VC in the input port of a switch is mapped by the switch control processor. The data transmitted using intact VC are always given to a controller, and this controller performs the conventional IP protocol stack containing required IP routing protocol.

[0013] Drawing 1 is for explaining the basic actuation of IPSOFACTO mentioned above. Each port of a switch constitutes IP interface. IP routing table of illustration used the output interface set as interfaces 2 and 3, respectively, and has specified the root to the destination networks 1.2 and 4.1.2. VC82 on the input-side port i is first mapped by the control processor.

[0014] The cel level change-over pass which transmits data in the above-mentioned system is set as follows. A transmitting agency chooses intact VC on an output link, and transmits the 1st packet of a new flow. This packet is received by the switch processor in the downstream of a link, next this switch processor chooses an output link based on that IP routing table. The selected output-link top is transmitted to this 1st packet by the processor by choosing intact VC on each link next.

[0015] In the example shown in drawing 1, the upstream router has chosen VC82, in order to exchange a new flow. The 1st packet of this flow is received by the illustrated router, next this router investigates IP routing table, and an output interface is chosen (in this case, 3). On an interface 3, in order to transmit a packet to the router of the downstream, VC51 is chosen. Since the switch control processor has all information <input port, Input VC, an output port, and an output VC> required in order to switch a flow, it adds an entry in a switch VC table. It is exchanged in all consecutiveness cels. At this time, the transmission by future packet levels becomes unnecessary with a control processor.

[0016] Unlike the data packet exchanged on cel level, the change-over pass for IP control messages is not formed. Usually, a control message is sent out and received on the control VC defined beforehand. Therefore, such a control message is transmitted through all switch control processors. This mechanism is used in order to set up the transfer condition for every flow. For example, the change in a transfer condition, such as separating an output interface, is used in order to change change-over pass (for example, <an out side port and VC> are deleted from VC table). If a control processor is canceled of a transfer condition, corresponding change-over pass will be released by marking an input and an output VC as intact.

[0017] B. The wireless ATM structure of a system of the wireless ATM system former is shown in drawing 2. It enables it to connect a base station to a mobile terminal through a radio link in such network architecture. Furthermore, the base station is connected to the core network through the cable link. Cel exchange is carried out in a base station, and the data from a cable interface to a wireless interface are TDMA (Time Division Multiple Access). Within a frame, an ATM cel is transmitted to a mobile terminal through a radio link. Thereby, ATM connection between end to end is made. By each base station, the mobile of the number of predetermined numbers can be supported in the domain.

[0018] It is used for wireless access of dynamic TDMA / TDD (Time Division Duplexing) ( drawing 3 ) protocol using centralized control on a WATM link. Control information and the down link (down link) information from the base station containing an ATM cel are multiplexed by single burst, and are transmitted to the head of the TDMA frame following a preamble and a

frame header. A base station controls the slot allocation to a mobile [ in an up link (above link) ]. up link control information — a bandwidth allocation demand — containing — ALOHA contention mode — a slot — it is—izing and sent out. The detail of a TDMA/TDD frame format is indicated by "Design and Performance of radio access protocol in WATMnet, a prototype wireless ATM network" (Proc. ICUPC, 1997) by P.Narasimhan, S.KBiswas, C.A.Johnston, R.J.Siracusa, and H.Kim.

[0019] About IPSOFACTO, I hear that it is received by the wireless layer in all mobile terminals, and an important thing has all the cels on a downlink burst. However, DLC to the terminal which filtered the receiving cel based on VC number by the MAC (Media Access Control) layer in each mobile terminal, and was beforehand opened by VC (Data Link Control) A cel is transmitted to a layer. Up link transmission is performed to a point-to-point, and a cel is transmitted to a base station through each slot from a terminal. In the MAC layer in a base station, only when corresponding VC is already opened, a cel is transmitted to a DLC layer. The space currently assigned to VC in both directions is common to all mobile terminals. In the case of the conventional wireless ATM system, although an access link is shared among all mobiles, the control VC according to individual is used to each mobile.

[0020] B.1. It is calling it multicasting to transmit an IP packet to a host's subset on a background network. As main advantages of multicasting, in case a packet is sent out to the group of a reception place, it is raised that the overhead in a network and a host is low. It is reserved for multicast actuation of the class D address of IP (IPV4) address space (from 224.0.0.0 to 239.255.255.255). A multicast address does not specify a certain IP interface in the Internet, and specifies [ instead ] the interface group. The multicast is fully supported by Local Area Networks, such as Ethernet equipped with efficient broadcasting distribution and large-scale multicast address space.

[0021] With the filter of the hardware level in a Network Interface Card, non-wanted datagram is removed, before reaching IP layer. In order to operate a hardware filter, the IP multicast group destination must be changed into the link layer multicast address which can be recognized by network hardware in a network interface. In fact, when 27 bits of the low order of IP multicast address are mapped by 23 bits of the backmost part of the Ethernet address, an Ethernet multicast address is created. About this conversion, it is Gary. R.Wright and W.Richard It is based on Stevens. "TCP/IP illustrated, Volume 1 : Please refer to The protocols" (Addison-Wesley Publishing Co., Reading, Massachusetts, 1995). Furthermore, in a network, in order to copy a packet and to transmit to two or more destinations in a network, a multicast routing protocol is needed.

[0022] B.2. The multicast actuation on the point-to-point link using the multicast IPSOFACTO on a point-to-point link is also comparatively easy. In TOSURU of the transmitting cache entry will be carried out into a multicast transmitting cache by the 1st IP packet of the multicast flow which arrives at a switch controller. VC number and the port number (chosen by the upstream switch controller) of an arrival packet are obtained. Furthermore, about each output interface in the newly created multicast transmitting cache, IPSOFACTO chooses intact VC and transmits a packet to a downstream switch controller. Next, the entry of input port and the input VC is carried out to an output port and the switch hardware VC table corresponding to mapping on the list of outputs VC. All the consecutiveness packets within a flow are switched on cel level using the hardware multicast function of ATM switching structure.

[0023] B.3. The multicast on a WATM link : some new problems arise in the multicast on the definition share wireless access link in question. The link which can be set in this case logically produces one of the problems of these by being broadcasting in a down link and being a unicast in an up link. When performing a multicast to a group with a mobile, it is necessary to map IP multicast address to the link layer address like Ethernet. The mobile which does not belong to a multicast group is a hardware level, and needs to remove non-wanted data suitably. (Wireless) The link layer identifier for ATM is a virtual channel (VC) number. It is necessary to map IP multicast address for VC number in order to attain the result of a request.

[0024] I hear that another trouble in a wireless ATM system needs to improve the activation throughput in a transport layer, and there is. Since the bit error rate (BER) of a radio link is very

higher than the bit error rate of a fixed ATM network, the error restoration mechanism of the cel level which prevents the fall of a packet level throughput is needed. The cel level restoration mechanism over the traffic class from which a unicast connection differs is discussed by "Data link control protocols for wireless ATM accesschannels" (Proc. ICUPC, 1995) by H.Xie, P.Narasimhan, R.Yuan, and D.Raychaudhuri. Since an IP multicast flow is mapped in Multicast VC (UBR), a cel level error restoration (and cel sequencing) mechanism must be extended so that two or more reception places can be treated.

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[Translation done.]

**\* NOTICES \***

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**TECHNICAL PROBLEM**

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[Problem(s) to be Solved by the Invention] There are the following problems in the conventional approach at least.

[0026] - By the conventional approach, the wireless ATM link to a mobile terminal cannot be treated. Thus, it is indispensable to enable it to treat a wireless ATM link in order to fully realize potential capacity of a conventional technique like IPSOFACTO.

[0027] - The Internet Group Mangement Protocol (IGMP) is inadequate as stated to "Internet group management protocol, version 2" (Internet Working Group Request for Comments 2236 months, November, 1997) by W.Fenner. For this reason, effective amelioration and technique are required rather than it decreases the unnecessary multicast traffic between a base station and a mobile.

[0028] - The cel level error restoration mechanism is inadequate for treating two or more reception places.

[0029] The purpose of this invention is offering multicasting on the wireless ATM link to a mobile terminal, and solving the above-mentioned problem.

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[Translation done.]

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**MEANS**

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[Means for Solving the Problem] In order to realize the above-mentioned purpose, it has the protocol with which it was beforehand set for transmitting a packet flow to the destination through an ATM network in this invention. In the network system equipped with the node which has the source, and the router and ATM switch for transmitting an ATM cel sequence using an intact virtual channel identifier (VCI) The above-mentioned router relates one of two or more of the output ports with the above-mentioned intact VCI, without performing signaling by hop BAIHOPPU. By this When change-over pass is set and, as for the above-mentioned ATM switch, each of the above-mentioned ATM cel has the same VCI as the above-mentioned intact VCI An ATM cel is transmitted through the above-mentioned one among two or more above-mentioned output ports, without being based on control of the above-mentioned router. A multicast virtual channel (VC) the address corresponding to an IP multicast group It is obtained by mapping for VC number corresponding to the above-mentioned multicast VC, and the system characterized by at least one base station giving VC number to the new mobile which joins one of the above-mentioned IP multicast groups using the above-mentioned mapping is obtained.

[0031] The system by which a base station is characterized by determining the correspondence relation between VC and a mobile in the above-mentioned system as the above-mentioned amelioration is obtained. Moreover, in the further amelioration, the system characterized by building beforehand the congruence directional control VC for transmitting the control message between the unidirectional broadcasting VC to a mobile from the above-mentioned base station, the above-mentioned base station, and the above-mentioned mobile is obtained in the above-mentioned system.

[0032] Preferably, the control protocol between the above-mentioned base station and a mobile is VC. REQUEST and VC It has a RECLAIM control message and is Above VC. In order to require VC which should send out data of the above-mentioned base station, it is used by the mobile, and a REQUEST message is Above VC. A RECLAIM message is used by the base station in order to carry out reclaim of the VC assigned to the above-mentioned mobile.

[0033] The system characterized by carrying out reclaim of the above VC in the above-mentioned system as the further amelioration if the above-mentioned base station uses a timer in VC active state for an activity judging and the above-mentioned timer expires is obtained.

[0034] As still more nearly another amelioration, in the above-mentioned system, the above-mentioned base station detects a packet boundary, and the system characterized by the ability to merge two or more flows in one VC is obtained.

[0035] As still more nearly another amelioration, the system characterized by the above-mentioned base station maintaining a transmitting agency IP address, the multicast group address, and the mapping relation between VC numbers is obtained in the above-mentioned system.

[0036] Preferably, the above-mentioned base station broadcasts the above-mentioned mapping periodically, the mobile which does not participate in a message discards the above-mentioned message in IP level, and the mobile which participates in a message opens VC corresponding to the above-mentioned message. The above-mentioned broadcasting is more preferably sent out with an IGMP host membership enquiry (query) message.

[0037] As still more nearly another amelioration, an Internet Group Mangement Protocol (IGMP) is extended, a multicast mobile receives the above-mentioned IGMP message, and generates a suitable report, and the system characterized by a non-multicast mobile abandoning the above-mentioned IGMP message in IP level is obtained so that enquiry in the format of a down link IGMP message may be transmitted on Broadcasting VC in the above-mentioned system.

[0038] As still more nearly another amelioration, in the above-mentioned system, so that a report of the format of an up link IGMP message may be transmitted on the unicast control VC So that an Internet Group Mangement Protocol (IGMP) may be extended and all mobiles may receive the above-mentioned IGMP message The above-mentioned base station carries out rebroadcast of the above-mentioned IGMP message, and in order for mobiles other than the mobile which sends out an IGMP message to prevent generating the further report, the system characterized by resetting a timer is obtained.

[0039] another voice of this invention — if it depends like, in the multicast flow system for transmitting multicast traffic through a wireless layer, the system characterized by a data-link-control protocol (DLC) sending out NACK with a bit map vector when a reception place loses a cel using a negative-acknowledge (NACK) method, or only when the above-mentioned reception place receives a breakage cel will be obtained.

[0040] The system characterized by storing it in a buffer until the above-mentioned timer completes the cel which the timer was used in order to avoid a deadlock in the above-mentioned system, and was transmitted, and clearing it as still more nearly another amelioration after the above-mentioned timer completes the above-mentioned buffer is obtained.

[0041] Preferably, when loss is detected, a reception place maintains a reception place timer and the above-mentioned reception place timer has the almost same time out value as the time out value of the timer used in order to prevent a deadlock. Still more preferably, it requires resending until the above-mentioned reception place timer completes the above-mentioned reception place.

[0042] As the further amelioration, a transmitting agency has the accompanying Acknowledgement timer of the time out value connected to the above-mentioned reception place timer which has a half time out value mostly in the above-mentioned system. The above-mentioned transmitting origin resets an accompanying Acknowledgement timer when there are further data which should be transmitted, and the system characterized by the above-mentioned transmitting origin sending out an accompanying ACK message after the above-mentioned transmitting origin transmits the last group's cel is obtained. If the above-mentioned reception place receives an accompanying ACK message including the sequence number of a transmission cel preferably, it will judge whether cel loss produced the above-mentioned reception place, and the NACK message which shows that cel loss arose will be returned.

[0043] According to another mode of this invention, in a wireless ATM system, the system by which VC space is characterized by being divided into Unicast VC, Broadcasting VC, and Multicast VC is obtained. As the further amelioration, the system characterized by a unicast IP address being mapped by the above-mentioned unicast VC is obtained in the above-mentioned system.

[0044] As still more nearly another amelioration, the system characterized by a multicast IP address being mapped by the above-mentioned multicast VC is obtained in the above-mentioned system.

[0045] As still more nearly another amelioration, the system characterized by a broadcasting IP address being mapped by the above-mentioned broadcasting VC is obtained in the above-mentioned system.

[0046] According to another mode of this invention, it sets to the multicast group subscription approach for a mobile. In the step which starts connection with a base station on a radio control channel, and the above-mentioned mobile The step which receives the response containing a broadcasting VC number and the unicast control VC number which the above-mentioned mobile should use, The step which sends out an IGMP subscription message on the above-mentioned control VC, and the step which searches a base station database in order to investigate whether mapping of <a group and VC number> exists, If VC is taken out from available VC pool, mapping

of <a multicast group and VC number> is created to Above VC and the above-mentioned mapping does not exist The step which stores information in the above-mentioned database, and when the above-mentioned mapping exists The step which offers VC by which existing was mapped, and on Broadcasting VC The approach characterized by having the step which transmits <the group address and VC number> to the above-mentioned mobile, and the step which opens VC corresponding to mapping of the above <the multicast group address and VC number> for data reception is acquired.

[0047] As the further amelioration, it sets to the above-mentioned approach. The above-mentioned approach Furthermore, the step which sends out host membership enquiry (query) on the above-mentioned broadcasting VC, The step which discards a message when a mobile does not belong to a multicast group, The step which starts the report delay timer which has the expiration value chosen at random when a mobile belongs to the above-mentioned multicast group who does correspondence, The step which sends out a host membership report on the above-mentioned broadcasting VC if the above-mentioned timer carries out a time-out, The approach characterized by having the step which carries out rebroadcast of the above-mentioned host membership report, and the step which will reset a timer and will not generate a report if rebroadcast is received is acquired.

[0048] As another mode of this invention, it sets to the multicast group balking approach for a mobile. The step which sends out an IGMP balking message to a base station using Control VC, The step which decreases the value of the counter combined with corresponding VC, and the step which confirms whether the above-mentioned counter reached zero, When the above-mentioned counter does not reach zero, the approach characterized by the step which continues transmission on Above VC, the step which closes VC which corresponds to the above-mentioned mobile, and having sending out a discharge message when all the counters became below zero is acquired.

[0049] In the approach used in order to map a mobile in a multicast group and to delete the above-mentioned mobile from the above-mentioned multicast group as another mode of this invention, the approach characterized by having the step which maintains the database of all the mobiles relevant to the above-mentioned multicast group, and the step which maps the group of all mobiles which has joined the above-mentioned multicast group in a multicast group is acquired.

[0050] still more nearly another voice of this invention — if it depends like, when it has the step which maps a multicast group in a counter in the approach used in order to map a mobile in a multicast group and to delete the above-mentioned mobile from the above-mentioned multicast group and a mobile will join the above-mentioned multicast group, make the value of the above-mentioned counter increase, and if the above-mentioned mobile secedes from the above-mentioned multicast group, the approach characterized by to decrease the value of the above-mentioned counter will be acquired.

[0051] moreover, another voice of this invention — if it depends like, when existence of a mobile is suggestively presumed from a multicast outing protocol and the mobile is not related with the multicast group in the approach used in order to map a mobile in a multicast group and to delete the above-mentioned mobile from the above-mentioned multicast group, the approach characterized by a release message sending out to the upstream is acquired.

[0052]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained to a detail with reference to a drawing.

[0053] The desirable example of this invention extends the IPSOFACTO system currently explained to the detail in the United States patent application 08th by ACHARIYA and others who is the artificer of this invention / No. 771,559 (Japanese Patent Application No. No. 350411 [ 09 to ]), and the United States patent application 09th / No. 080 or 208. The capacity which chooses intact VC to new IP flow as an important element in the conventional IPSOFACTO is improved. Since it points only to the terminal/switch which all intact VC has in the other end of a link in a bidirectional point-to-point link, it can choose easily.

[0054] On the other hand, the wireless ATM link in a WATM network system is supporting two or



more mobile terminals. Such a radio link has the broadcasting down link and the unicast up link. About this point, it is based on D.Raychaudhuri, L.J.French, R.J.Siracusa, S.KBiswas, R.Yuan, P.Narasimhan, and C.A.Johnston. "it is WATMnet. : Please refer to A prototype wirelessATM system for multimedia personalcommunication" (IEEE Journ. Select. Areas Commun., 1997 years).

[0055] A. Escape to WATM of IPSOFACTO: In order to support a different traffic type according to IPSOFACTO+W this invention, it is IPSOFACTO on a radio link. VC is classified into NIKYASUTO VC, Multicast VC, and Broadcasting VC. The data transmitted by Unicast VC are received by only one mobile. Similarly, the data transmitted by Broadcasting VC are received by all mobiles. On the other hand, the data transmitted on Multicast VC are received by only the group with a mobile.

[0056] Multicast VC is obtained by mapping the IP multicast group address for VC number. Such mapping is performed when a mobile joins a multicast group first. Also when joining the IP multicast group with other same mobiles by this mapping of <the IP multicast group address and VC>, a base station gives the VC number concerned. Mapping of 1 to 1 is maintained between VC and the IP multicast group address.

[0057] In order to perform multicast actuation appropriately for the asymmetry of a wireless ATM access link, it is required to correct an IPSOFACTO protocol. Since the same VC space is used by all the mobiles in a predetermined base station, VC cannot be beforehand prepared because of data reception. The control protocol between a base station and a mobile is used, and VC which a mobile should use by the base station is determined in such a control protocol.

[0058] Here, in order to support unicast traffic, such a control protocol is not sometimes required. This is because VC space is divided and it is assigned to each mobile, without producing contention. Division of VC space is not performed at the time of multicasting. This is because a mobile can join and/or break away dynamically at a multicast session.

[0059] On a WATM terminal, when IPSOFACTO is set up, the following VC is given beforehand.

[0060] - One direction broadcasting VC to a mobile from a base station.

[0061] - Bidirectional unicast control VC between a base station and a mobile. Since a control message is sent out, these control VC is used.

[0062] The control protocol between a base station and a mobile is VC. REQUEST and VC The RECLAIM control message is included. VC A REQUEST message is used by the mobile, in order to require of a base station so that VC which transmits data may be given. VC A RECLAIM message is used by the base station and used for carrying out reclaim of the VC given to the mobile. A base station is usually VC, when a timer is used in order to judge VC active state, and a timer carries out a time-out (i.e., if it will not be in an active state on the VC). RECLAIM is sent out.

[0063] When two or more transmitting origin exists in the same multicast group, other special features are incorporated. When the same VC is used to the multicast group irrespective of the number of transmitting agencies, the boundary of a packet (frame) is detected and the base station which can merge two or more flows into one VC is needed. When the base station in which such VC merge is possible cannot be used, different VC to each transmitting origin in a multicast group is used. In such a case, a base station maintains mapping of <a transmitting agency IP address, the multicast group address, and VC#>. This means that each mobile opens two or more VC to current and the same IP multicast group.

[0064] In order to improve dependability, a base station broadcasts mapping periodically. Such broadcasting is usually sent out with an IGMP host membership enquiry (query) message. The mobile which does not participate in this message only discards a message in IP level. It is useful to have mapping of <the source (transmitting agency), a group, and VC>, when a reception place uses IGMPv3 which can choose multicast traffic and can receive only from the set of specific transmitting origin. The mobile which participates in the set of specific transmitting origin should just open the corresponding reception VC.

[0065] B. Escape of IGMP: According to IGMP+W this invention, to an Internet Group Management Protocol (IGMP), modification and correction are added so that it can operate within the wireless ATM environment. IGMP is used by IP host in order to report host group member cypridium

conventionally to the multicast router which adjoins directly. In a wireless ATM system, the base station itself may be a multicast router, or the conventional IP router may be the alternative which can operate as different hop.

(hop=passage of a data packet between two network nodes(for example, between two routers)  
 proxy=Entity that, in the interest of efficiency, essentially stands in for another entity <- from the Internet data)

Below, the case where the base station itself is a multicast router is explained.

[0066] A multicast router sends out a host member cypripedium enquiry (query) message, in order to find out whether it has the member on the local network to which which host group is connected. It is taken out by all hosts' group (address 224.0.0.1), and enquiry (query) is IP. TTL (time two rib [Time-To-Live] duration) = 1 It is transmitted by making it [(Field in an IP header that indicates how long a packet is considered valid.)). By creating a host member cypripedium report, a host answers enquiry (query) and reports each host group to whom self belongs on the network interface which received enquiry (query). In order to avoid the congestion by the concurrence of a report and to reduce the total of the report transmitted, two technique is used in the conventional IGMP.

[0067] 1. Choose a delay timer value at random. The response to enquiry (query) is generated at the time of the time-out of a timer. This is useful to distributing a response in time.

[0068] 2. A response report is taken out to the host group address, where TTL is set as 1. Other members of a group same on the same network can see the report, and can control that another report is created to the group. The load of IGMP can be decreased by this.

[0069] In order to attain the same actuation on a wireless ATM system, in this invention, following modification/escapes are performed to IGMP.

[0070] 1. A down link IGMP message (query) is transmitted on Broadcasting VC (from a base station to a mobile). The mobile (host) in which all multicasting is possible receives IGMP and a query message, and creates a suitable report. Although the mobile which cannot be multicasted can also receive these messages, these messages are discarded in IP level.

[0071] 2. An up link IGMP message (report) is transmitted on the same unicast control VC. If this report is received, since a base station will carry out rebroadcast of the report, other mobiles can receive the report created by the host (mobile) belonging to a multicast group. When another host is the same group's member, the timer is reset and it is made to refrain from creation of another report.

[0072] C. subscription in the multicast group of a new mobile, or balking — explain the step which performs multicast actuation at the time of a mobile newly joining the wireless ATM system concerning a desirable operation gestalt. In drawing 2, M1, M2, and M3 are three mobiles connected a base station and now. Mobiles M1 and M2 join a multicast group, 225.1.1.1 [ for example, ], multicast data are received, and the case where it finally secedes from a group is explained.

[0073] A base station needs to determine the stage when mapping should be added from a database, and the stage which should be deleted so that a mobile can join or break away proper. It is comparatively easy to add a new entry. When a mobile joins a multicast group and this group's mapping does not exist yet in a database, an entry is newly added. However, if the stage when an entry should be deleted is determined from a database, a base station needs to confirm that the mobile station connected with the specific multicast group address concerned does not exist. In order to acquire such information, a base station can maintain a mapping database by three different approaches.

[0074] 1. Map the list of mobile IP addresses which join a source (transmitting agency) IP address, i.e., <the multicast group address and VC number>, and this group.

[0075] 2. Map a source (transmitting agency) IP address, <the multicast group address and VC number>, and a counter (or flag).

[0076] 3. Map a source (transmitting agency) IP address, and <the multicast group address and VC number>.

[0077] In the 1st case, a database with all the perfect mobiles relevant to a multicast group will be held. Maintenance of a database will be complicated although great flexible SHIBIRITI and

functionality are acquired by having perfect mapping.

[0078] What is necessary is just to count up a base station, when a mobile joins a group, and to hold the counter counted down when seceding from a group in the 2nd case. If all mobiles secede from a group, a counter becomes zero and can delete an entry from a group safely. Here, there is not even need of continuing supervising how many mobiles being connected with the group address now. What is necessary is just to use the flag (a condition 0 and condition 1) set as zero (reset), when it is set as 1 and a mobile does not exist, as long as at least one mobile exists.

[0079] In the 3rd case, the information about the mobile connected with the specific multicast group address existing can be suggestively presumed from a multicast roux TIGU protocol. When the mobile is not connected with a multicast group, a base station (it is also a multicast router) sends out a discharge message to an upstream router, in order to separate the multicast traffic to the group. This message is generated by the multicast routing protocol only when there is no host (mobile) connected with that multicast group. This message can be used as a trigger for deleting the entry from a database.

[0080] An assumption of a two or more-IGMPv protocol performs the following operating sequences.

[0081] - If it goes into the area (it is usually called a cel) where a mobile is controlled by the base station, connection actuation with a base station will be started through a radio control channel. This is the communication link mechanism of wireless level.

[0082] - A base station answers by giving a broadcasting VC number and the unicast control VC number which a mobile should use with other information.

[0083] - A mobile M1 determines to join the IP multicast group 225.1.1.1, and transmits an IGMP subscription message on Control VC. When using a PIM[Personal Information manager] DENSU (dense) mode multicast routing protocol, a graft (Graft) message is created by the base station and it is sent out to the router of the upstream.

[0084] - Next, a base station searches the database and investigates whether mapping of <a group and VC number> exists. In not existing, a base station chooses VC from the pool of available VC, maps this VC to the multicast group address, and stores information in a database. This information (<the group address, VC number>) is transmitted to a mobile through Broadcasting VC.

[0085] - if this mapping is received, a mobile opens predetermined VC for data reception. Here, other mobiles which received this information only discard this.

[0086] - Decision of joining the group (225.1.1.1) with the same mobile M2 sends out a subscription message to a base station. A base station's reception of this message searches a database in search of <group and VC> mapping. Since such mapping already exists, the same VC number is given to a mobile. A mobile M2 opens this VC for data reception.

[0087] - A base station sends out a host member cypridium query on Broadcasting VC (255) periodically. Hosts other than M1 and M2 will discard this message. If M1 and M2 receive this message, these mobiles will start the report delay timer with which the time out value was chosen at random. In order that a host may reduce the probability which chooses the same delay value, it is RFC (Request For Comment). It is recommended as some seeds then for pseudo-random number generators that a host's own IP address is used. Gary R.Wright and W.Richard It is based on Stevens. "TCP/IP illustrate, Volume 1 : Please refer to The Protocols" (Addison-Wesley Publishing Company, Reading, Massachusetts, 1995).

[0088] - If a timer carries out a time-out by one mobile, a host member cypridium report will be created and it will be sent out on Broadcasting VC. A base station receives and broadcasts this message (\*\*). If other mobiles receive this message, that timer will be reset and a report will not be created.

[0089] - A base station transmits multicast data to the group (225.1.1.1) of VC obtained from <group and VC> mapping. Since VC same for reception of both mobiles M1 and M2 is opened, both receive multicast data. All other mobiles discard this data.

[0090] - IGMP balking actuation is performed similarly.

[0091] D. Explain the desirable operation gestalt of the data-link-control (DLC) protocol for

transmitting multicast traffic through the data-link-control wireless (physical) link for a multicast flow below. Such a protocol decreases a cel error rate and performs sequential cel distribution which can obtain a high throughput in a transport layer. It is shown by by using a data-link-control protocol that the effectual throughput of unicast traffic is improvable. P. Narasimhan, S.KBiswas, C.A.Johnston, R. J.Siracusa, H. "Design and by Kim performance ofradio access protocol in WATMnet aprototype wireless ATM network" (Proc.ICUPC, 1997) and H.Xie, P. — "Data link control protocols for wireless ATM access channels" (it ICUPC(s) Proc. [ ] —) by Narasimhan, R.Yuan, and D.Raychaudhuri Please refer to 1995.

[0092] IP multicast traffic is based on UDP (User Datagram Protocol), and although packet loss is not related, if restoration is performed on cel level, an activation throughput will improve sharply. Even if one of the ATM cels loses the improvement of such a throughput, the whole UDP datagram is treated as a code error in breakage and CRC (Cyclic Redundancy Check) of a packet, and it originates in being discarded. By restoring the lost cel, the whole packet can be restored and the total throughput of a transport layer can be raised.

[0093] The positive (it is affirmative) group check method is used for the data-link-control protocol for unicast flows to error restoration. A reception place sends out the group check packet equipped with the bit map vector which shows the error condition of the received cel. If the check packet concerned is received, a transmitting agency will analyze a bit map vector and will resend the lost cel alternatively. However, a transmitting agency will be burdened with the burden for check traffic when the mechanism for such multicast traffic is used. In order to avoid such a situation, only when the cel which the negative-acknowledge (NACK) method was used, and the cel lost in this case, or was damaged is received, NACK is sent out with a bit map vector from a reception place ( drawing 4 ). If a negative-acknowledge packet is received, a transmitting agency will perform an alternative resending algorithm in order to restore an error cel. Here, DLC activation is performed in the mode for every VC, and it needs for both a base and a terminal to hold the DLC status information according to individual for every VC. Furthermore, since a base station can distinguish Unicast VC and Multicast VC, it recognizes the right mechanism (ACK or NACK base) which should be used for error restoration.

[0094] Many mobiles belong to the same multicast group, and when operating by the basis in the conditions (phasing etc.) that various errors tend to occur, a burden called the repeat of a resending demand may be placed on a base station. In this case, in order to add the load which answers a resending demand, in a base station, there is a possibility that it may become impossible to transmit new multicast data. According to this invention, a timer is used in order to prevent a deadlock arising. It is put in by the buffer until a timer carries out the time-out of the transmitted cel, and a buffer is cleared after a time-out ( drawing 6 R> 6 ). A reception place requires resending of the cel which is due to be received, unless a transmitting agency timer carries out a time-out. All resending demands will be discarded if a transmitting agency timer carries out a time-out. A reception place maintains an own timer. This timer will be started if cel loss is detected. The time out value of this timer is almost the same as the time out value of a transmitting agency timer. Unless a reception place timer carries out the time-out of the reception place, cel resending is required, and a reception place does not require resending any longer about the group's cel after a time-out, assuming that data were lost. This is the need. Although a transmitting agency does not answer the flume in which the timer carries out a time-out, or the resending demand which it becomes by this, either, a reception place can prevent sending out the demand of resending of the lost cel continuously and vainly.

[0095] The transmitting agency has the additional timer with a time out value equal to the abbreviation one half of the time out value of a resend timer. when the time-out of this timer is carried out, it is subordinate — [gratuitous] — since an Acknowledgement is sent out, it is used. This is useful, when the cel which should be transmitted does not remain any more, or when a long gap is in a data stream. When the mechanism of the NACK base is used for error restoration, the method of telling a reception place about the cel having been transmitted is needed. Usually, when there are data to transmit further, a transmitting agency resets a subordinate Acknowledgement timer. This is because it is shown by the reception place that a previous group's cel was lost by reception of a consecutiveness cel. A reception place creates

the suitable NACK packet equipped with the right bit map vector for restoring the lost cel. Nevertheless, cel loss may not be detected by the reception place when a transmitting agency transmits the last group's (or group before a long gap) cel. This is because it does not turn out at all that the cel was transmitted. In such a case, a transmitting agency sends out the subordinate acknowledgement message which shows that a group's cel was transmitted. If a subordinate acknowledgement message including the sequence number of the cel to which the reception place was transmitted is received, it can judge whether cel loss arose and a letter can be answered in a NACK display. Before a resend timer carries out the time-out of the reason of having a smaller time out value here, it is for giving a chance creating NACK and restoring a loss cel to a reception place.

[0096] In this invention, the mechanism for offering an IP multicast to a wireless ATM system is acquired. VC is classified into Unicast VC, Multicast VC, and Broadcasting VC in order to distinguish a different traffic type. The control protocol between a base station and a mobile is used in order to give the suitable multicast VC number used when joining a specific IP multicast group to a mobile. Warm modification/escape to the IGMP protocol especially used in a wireless ATM system are obtained. In order to raise the effectual throughput in a transport layer at the last, the data-link-control protocol which has a negative acknowledge was explained to it.

[0097] If it is this contractor, modification and deformation of others of this invention will be clear from the above-mentioned explanation. That is, although this invention was explained only about some examples, it cannot be overemphasized that much modification is possible, without deviating from the meaning and the range of this invention.

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[Translation done.]

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- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

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**DESCRIPTION OF DRAWINGS**

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**[Brief Description of the Drawings]**

[Drawing 1] It is drawing showing the example of the conventional IPSOFACTO actuation.

[Drawing 2] It is drawing showing the conventional configuration of a wireless ATM system.

[Drawing 3] It is drawing showing the TDMA/TDD frame format used for Wireless ATM.

[Drawing 4] It is the logic diagram of the data-link-control protocol for multicast traffic.

[Drawing 5] It is drawing showing an alternative resending mechanism.

[Drawing 6] It is drawing showing the timing information about the mechanism of the NACK base.

**[Description of Notations]**

2 Three Interface

51,82 VC

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[Translation done.]